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Demonstration of Smart Waste Segregation and Utilization System for Smart City

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***Abstract*— The world faces major environmental challenges associated with waste generation and waste collection , transport, treatment and disposal, by increase in population, volume of waste generation is also increased, this impacts on the environment and public health. Even the private areas which are clean enough failed to utilize the resources efficiently. This waste management system includes segregation of waste into different parts at the local area itself and which are further used as raw material for different process such as power generation, recycling etc. Also it creates clean, hygienic and advanced waste damping area. The generated power can be utilized for domestic and commercial purpose.**

***Keywords*—Aurdino, Bins, Motors, Municipal Solid Waste, Smart Bin, Smart Waste Management, Sensors, WTE.**

I. INTRODUCTION

Solid waste management (SWM) is a major problem for many urban local bodies (ULBs) in India, where urbanization, industrialization, and economic growth have resulted in increased municipal solid waste (MSW) generation per person. Effective SWM is a major challenge in cities with high population density. Achieving sustainable development within a country experiencing rapid population growth and improvement is living standard is made more difficult because it is a diverse country with many different religious groups, cultures, and tradition. Due to financial constraints, proper municipal solid waste collection and disposal mechanism is not in place, municipal solid waste management is not been recognized as a major attribute for the pollution of air, water, and soil pollution.

In process of waste management, one of the most important steps is to segregate waste because while disposal of waste consumes large landfill if it continues for upcoming decades there will be on land for human use. So it's our primary duty to segregate waste into different parts. Technology provides economical, effective, and easy to implement solution. Waste management is one of the important steps in the progress of the nation, considering a large amount of solid waste is produced, technological solution to this problem to thus mandatory.It is discrete state control system to prevent over-dumping of waste in bins and automatically sorts the mixed waste into different types of waste based on the nature of the waste, then these separated wastes are used as the raw materials for other processes such as power generation for waste damping areas, recycling of waste bricks production, etc. By this the waste is segregated at the colony or area itself further the waste dumping area will become more hygienic. Thus it can be made a smart city and maximum revenue for the city come from the waste management system.

II. METHODOLOGY

This chapter describes the block diagram and working system of the Demonstration of waste segregation and management system for the smart city. The waste segregation and utilization system for a smart city project are working in two different steps. First, the waste is segregated into different types of wastes in the waste bin itself in the local area and this separated waste is used as raw material in the second step that is in the waste management plant.

SMART BIN

Segregation of waste is carried out in the waste bin and block diagram of segregation of waste in smart bin as shown in the fig 1

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The prototype sensor-based waste segregation unit mainly consists of a power supply unit with the 230V AC and this power voltage is converted to DC using the SMPS at a value of 12V DC

further using the power distribution board the voltage is dropped down to 5v for sensors and the actuators as well as the controllers in the project. Basically, once the power supply is provided to the system the Controller comes into action based on the programming that was made by the user. Considering the moisture sensor for the wet segregation the sensor keeps on monitoring for the wet waste entering into the sensor area and if a wet waste is detected it sends the signal into the Arduino Uno and this Uno generates a signal to the respective servo to push the wet waste into the wet waste collector Bin. In the same was the Capacitive sensor for detecting the plastic and the Inductive sensor is used to detect the metallic wastes. These two sensors are in connection with the Arduino Uno and the respective signals are generated towards the appropriate output servo motors.

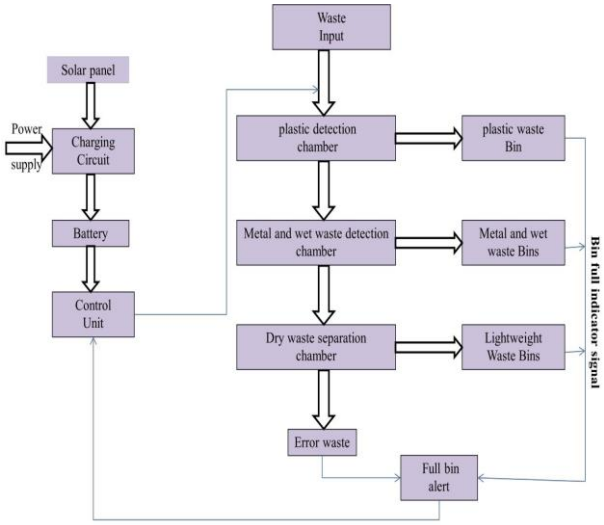


Fig 1 Block Diagram of Smart Bin

The light-based sensor mainly works on the basis of light-emitting device spreads the light over the photodiode and when the glass comes in front of the sensor, it generates a signal to the Arduino UNO and from there the output will be generated to the active servo drive. The fan which will be running continuously will blow away the lightweight wastes like paper and wrappers. The conveyor motors will help in starting/stopping the conveyors according to the servo drive motors, like when the servo drive pushes the waste away towards the waste bins the conveyor stops and start once after the waste is put into the bin. The motors are connected to the controller with a help of the mechanical relay units in order to handle the large voltages of the motors. The solar panel in connection with the system will generate a 12v supply and it charges the battery via the solar charger. The battery cut is controlled in the solar charging unit in order to save the battery from overcharging and damaging. Each bin in the smart bin is incorporated with a level detector basically an IR sensor that detects the fullness of the waste bin when the waste bin is full it sends a signal to the control unit then the control unit sends the signal to the authority that the waste bin is full. The segregated waste which is collected in the different bins are used in the waste management plant i.e. the second stage of the project to utilize the waste in effective manner.

WASTE UTILIZATION PROCESS

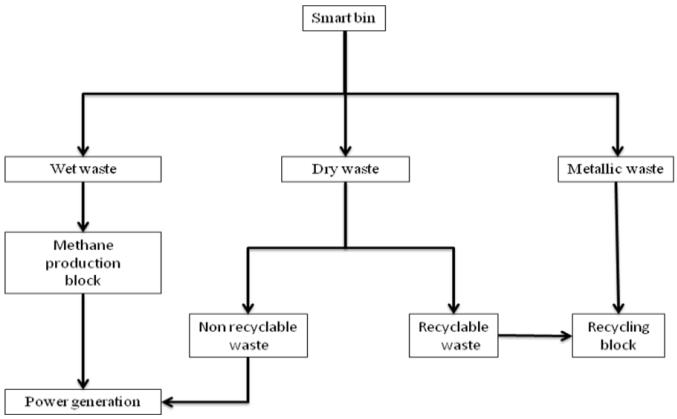


Fig 2 Block Diagram for Utilization of Waste

III.

In the second stage, the segregated waste like wet waste is used for methane production, recyclable plastics, aluminum used for recycling process. Non recyclable materials are used for bricks manufacture or power generation process along with methane as the primary component as shown in the fig 2

UTILIZATION OF METALLIC WASTE

From the metal waste bin, metal wastes are used for the recycling processes are used for making Metal can be recycled over and over again without the degradation of any of its properties. In fact, some recycling processes today can improve the material. An Electric Arc Furnace, for instance, can process scrap steel to increase its strength

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and durability, making it even more suitable for use in products such as building beams or railroad tracks. Manufacturers opt to use recycled metal because it is less expensive than metal derived from mined ore.

UTILIZATION OF DRY WASTES

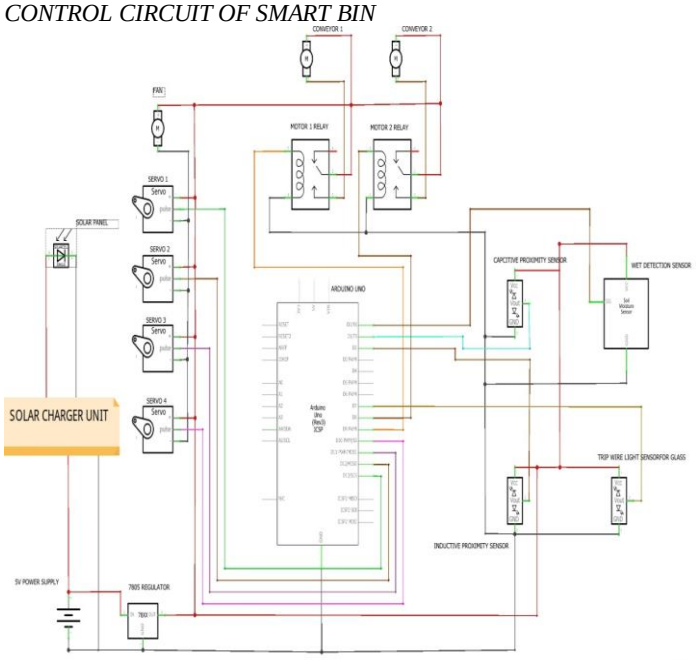
In dry waste which may include lightweight waste such as juice can, plastic, etc.. This waste is further classified into recyclable and non-recyclable using suitable cost-effective processes and the recyclable plastic used for recycling industries to make new products and sold them into the market so that it will get revenue. Also the glass waste which is collected in glass waste bin is used in recycling block i.e. it is added in the melting process of glass making. Non recyclable wastes can be used for burning process in power generation.

WASTE TO ENERGY

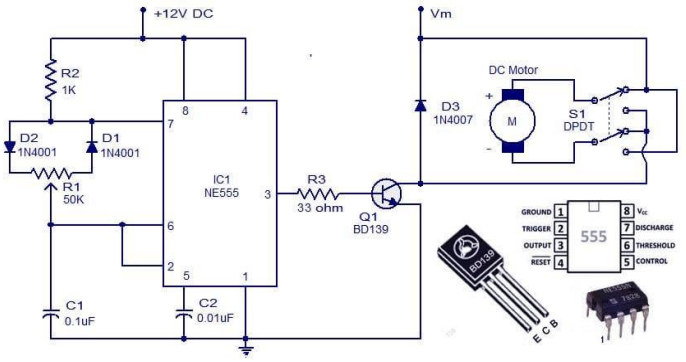
Wet wastes are basically consisting of food waste, vegetable waste, and degradable wastes. These wastes can be used for power generation by waste to energy (WTE) plants. Wet waste is used for the generation of methane and it is used for burning process with non recyclable waste to produce steam for generation of power.

IV. CIRCUIT DIAGRAMS

CONTROL CIRCUIT OF SMART BIN



SPEED CONTROL CIRCUIT FOR CONVEYOR MOTOR



V. CONCLUSION

After testing the smart waste bin with the different types of waste, it has been found that. The design is efficient in segregating metal, wet, plastic, glass, and wood wastes and storing them in the specified bins. Detection of specified waste by the specified sensor and controlling mechanisms to push or place the waste in a respective bin are working according to our requirement. The design is simple and cost-effective to use as a waste bin in the local areas and a small innovative initiation for segregation waste bin itself which will avoid the dumping of wastes mainly plastic or non-biodegradable waste into the landfill.

VI. RESULTS

The prototype here holds up a variety of sensors to detect different types of wastes such as metal, wet, plastic, glass, and wood waste for segregation. After testing we obtained the following results.

1) When the sensor detects the waste and control signal for an actuator for push mechanism is get activated to store the waste in the specified bin.
2) First stage of the smart bin can detect wet and metal waste using an inductive proximity sensor and store the waste in the specified bin.
3) In the second stage of the smart bin lightweight waste has been collected in the lightweight bin using a blower fan, glass and wood waste are separated using laser detection and placed the waste in respective bin
4) At last the mixed waste placed in single plastic cover and troughed to waste bin are collected in the last waste bin i.e. Error waste bin. Each bin is monitored using a level detector that detects the fullness of the bin

5) The moment of conveyor belts can be controlled by varying the speed of the DC motor using LC298I

ADVANTAGES

The advantages of smart waste segregation and utilization system for smart city are

- Waste id segregated in the waste bin itself which will reduce the dumping of waste in the land.
- This is simple and cost effective waste bin model helps in maintain surrounding environment clean.
- By the utilization of waste into different product, leads to clean and hygienic environment.
- Saves the earth and conserves energy, it includes specially the recycling aspect, power generation conserve energy and lower the consumption of earthly resources.
- Utilization of waste created revenue for the government or local bodies.
- Waste management plant helps to earn money and creates employment.
- Waste to energy conversion plant produce power which reduces the power crises.

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